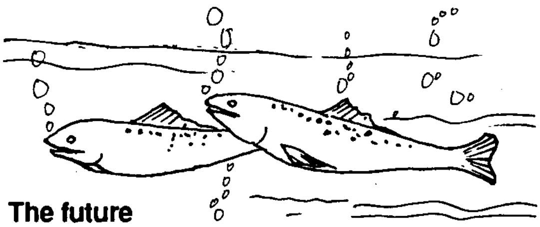
Under laboratory conditions, oxygen injection can improve growth of rainbow trout. The test in actual hatchery production yielded similar results:

Production parameters	Normal spring water	Oxygenated water
Dissolved oxygen (ppm)	6.2-5.0	8.6-5.0
Water flow (l/min)	2,000	2,000
Flow index	0.73	1.58
Fish produced:		
Total weight (kg)	1,050	2,300
Length (cm)	15	15
Mean length increase (cm/day)	0.5	0.6
Number of fish	27,800	60,300
Feed conversion	1.35	1.10

Both systems ended up with 5.0 ppm of dissolved oxygen at the end of the run. But the oxygenated water produced more fish.

If a hatchery has a raceway series, it is possible to supersaturate the water from the first series and deliver it to the next. A triple pass using oxygen saturated water is even possible.



The future

Managing a fish hatchery with oxygen injection is very challenging and the increased production potential astounding. There is no question that oxygen injection improves water quality and increases production capabilities. There are continuing efforts to reevaluate and to expand the oxygenation system to further increase production. Delivery channels between systems may be changed and additional injection sites selected.

Oxygen injection can help meet increased demands on our limited water resources.

Reference: RD Creer. *Managing a hatchery with oxygen injection.* **Aquaculture Magazine** Vol. 15. 1989.

Inexpensive hatchery alarm system

The main component of the alarm system is a commercial security alarm controller with an autodialer and siren. This device is connected to sensors that monitor water-recirculating systems for failure and to infrared and intruder-entry switches.

In the recirculation system, two uninsulated steel wires 2 mm in diameter, parallel and 20 cm apart, are installed throughout the length of the hatchery. At one end, the parallel wires are connected by two-core insulated wire to one sector of the security controller. The circuit to this sector of the controller is normally open, and the alarm is triggered when the circuit is completed.

A series of sensors monitors air supply, dissolved oxygen level, water level, and water flow. Each sensor contains a switch, which is also normally open, and is connected by a two-core wire across the parallel wires. A failure in the system closes the sensor switch, bridges the parallel wires, and triggers the security controller.

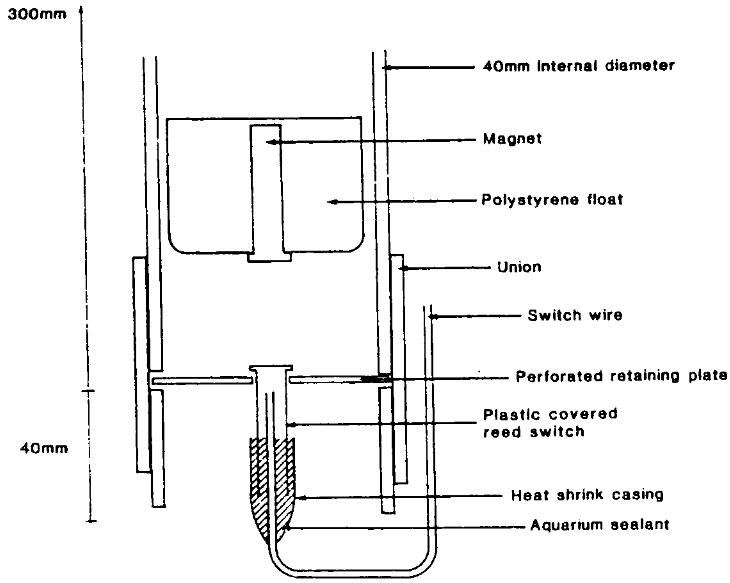
The sensors are connected to parallel wires via alligator clips so that each sensor can be easily removed without disrupting the rest of the system.

All sensors, except the dissolved oxygen sensor, are designed around a simple float-switch assembly. The switch assembly (see figure) is used to monitor water level, air supply, and water flow through the filter, and can also be used to operate water-valve solenoids or pumps through appropriately rated power relays.

The water-level sensor consists of a 300-mm length of tube with the float-switch assembly in the base. The sensor is hung over the side of the tank, and the height adjusted with the cord. The magnet float is retained inside the pipe by the suspension cord.

These sensors have proved to be more reliable than commercial float alarms. Commercial designs include a mercury switch which closes when the float is tipped. These mercury-switch sensors are triggered by fish movements as well as by falling water levels. The homemade water-

☞



Cross section of the switch assembly for water level, air supply, and water flow sensors.

level sensor can be tipped through 45° without closing and returns readily to the vertical position.

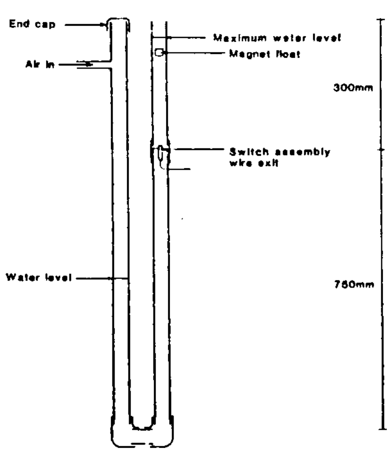
A water-filled manometer and switch assembly at the end of the water supply line can monitor air pressure.

To create a delayed-action water-flow sensor, a 4-mm tube diverts a small proportion of the water, from the top of the supply to the biofilter, into a 40-mm vertical pipe. The top of the vertical pipe is above the maximum water level of the header tank, and the outlet is closed by a loosely fitted end cap. A 4-mm diameter hole is drilled through the wall of the end cap and pipe. In use, the end cap is rotated to restrict the water exit so inflow exceeds outflow and the pipe is always full. If the pump fails, the water level in the pipe falls, and the floating magnet closes the reed switch. The interval between flow failure and sensor closure can be set to between 5 to 30 min to allow time for the pumps to reprime in case of temporary failure.

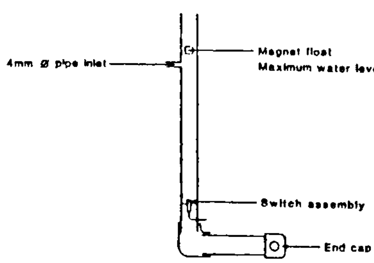
The dissolved oxygen sensor is designed to operate with a YSI model 54 or 57 oxygen meter (Yellow Springs Instruments Corp., Yellow Springs, Phio). These models give a recorder output at a full range of 120 mV. The trip circuit is designed so the relay closes and triggers the alarm if the trip-circuit or meter batteries fails or if the dissolved oxygen concentration falls below a preset level.

At high oxygen levels, current from the batteries is diverted through the relay, thus opening the switch. If the output from the oxygen meter falls below the preset trip value, the current is diverted away from the relay so the switch closes. The trip value can be adjusted by a trim or variable potentio-meter to between 25 and 50 mV. In practice, this corresponds to 2-6 ppm of dissolved oxygen on the 0-10 scale and 4-12 ppm on the 0-20 scale on the YSI meter.

The cost of components for the dissolved oxygen sensor is about $16 from an electronics supplier. A competent electronics technician should be able to alter the values of the balancing resistors to adjust the circuit for other brands of potentiometric oxygen meters with differing recorder outputs or impedance requirements.



Water-flow sensor



Air-flow sensor

Reference: NH McCarter. *Inexpensive sensors for a hatchery alarm system.* **The Progressive Fish-Culturist** Vol. 5. 1990.